

this anomalous motion has arisen from the action of solar tides. Finally we have in this miniature system of Mars a foreshadowing of the ultimate destiny of our earth and our moon.

Do I say the ultimate destiny? Nothing is ultimate in nature. The moon and the earth would have come to an amicable and a final agreement had they been let alone. But now the sun has intervened and disturbed the earth's rotation. The truce once broken, the moon again produces tides on the earth, the earth reacts on the moon, and a whole chain of complicated movements are the consequence. I shall not now attempt to trace the further progress of events.

I have dealt with very large figures in this lecture, and perhaps I have taxed your imagination by my demands that you should conceive of periods of tens of millions of years. Yet after all let us look at the results in their true proportion, compared with the universe in which our lot has been cast.

Truly we have been engaged with a very trifling matter. Is not our earth one of the most insignificant bodies in the universe? And our moon is much smaller still. Nor is it even the life-history of our earth that we have been considering, it is merely a brief episode in that history. What are the periods of time we have been discussing when compared with those infinitely longer periods during which the solar system has been evolved? Even the solar system is but one out of one hundred million such systems, each of which has its own life-history. Viewed in their true proportions, the phenomena I have described are but of infinitesimal importance, and the time they have occupied is merely ephemeral.

No doubt we have only dwelt upon the tides on the earth and the tides in the moon, which have been of such infinite importance. But do not suppose that tides are confined to the earth and to the moon. So far as we know, every body in the universe is capable of producing, and actually does produce, tides in every other body. Every planet throbs in response to the tides produced in it by every other planet. Every star has a distinct tidal wave produced in it by every other star. You may say that such tides are infinitesimal, but you must remember that infinitesimal causes, sufficiently often repeated, can achieve the mightiest effects.

We know that tides have wrought our solar system into its present form; and are we to say that the wondrous powers of the tide have no grander scope for their exercise? I prefer to believe that tides operate far and wide through the universe, and that in the recognition of the supreme importance of tidal evolution we mark a great epoch in the history of physical astronomy.

POPULAR NATURAL HISTORY¹

THE present volume of this finely illustrated work finishes the account of the Vertebrates with the history of the Fishes, and gets over as well an immense mass of the Invertebrates. The story of the Fishes is contributed by Prof. H. G. Seeley, who, in the limited compass of 150 pages, of which about one-sixth is occupied with figures, has given a very fair and comprehensive notice of this class. The Fishes are the only primary division of the Vertebrata which live in water, and have no representatives passing their lives upon land or in the air. This condition of existence is probably the cause of the close correspondence in bodily form in the majority of fishes, which progress through the water chiefly by movements of the tail, and use the fins as organs with which to steer a path. "Clear as is the idea which rises in the mind at the mention of a fish, the multitude of forms which fishes exhibit are greater, perhaps, than those to be found in any of the other great groups of Vertebrate

animals described in the previous four volumes of this series. The slender form of the lamprey or eel contrasts with the expanded body of the turbot or the plaice; the short deep form of the sun-fish is unlike the broad, flattened, and long-tailed skate; the sea-horses, when attached to sea-weeds by their prehensile tails, at first sight present none of the familiar characteristics of fishes. The flying-fish, which have the fins so expanded as to serve some of the purposes of wings, present a remarkable contrast to the spheroidal spiny body of the globe-fish, while the hammer-headed shark exhibits a form of body in some respects more singular still. When we turn to details of proportion and structure, and contrast the shapes of the head or of the tail, the variety among fishes is altogether exuberant."

As an illustration of the woodcuts to be found plentifully in this volume, we select a sea-horse some time since described by Dr. Günther, the strange *bizarre* form of which will at once attract attention. The illustration is a very fair copy of the beautifully-drawn figure of Mr. Ford in the *Proceedings* of the Zoological Society of London for 1865, and represents, of the natural size, a specimen of *Phyllopteryx eques* from South Australia. "There is no doubt," writes Dr. Günther, "that these fish attach themselves with the prehensile end of their tails to stems of sea-weed and other objects; and when they are in the vicinity of sea-weed of a similar colour to themselves, their resemblance to it must be so great that they would easily escape being observed by their enemies." We fancy that Prof. Seeley is wrong in stating that, "as the name implies, this fish has very much the aspect of a moving plant." The idea in Swainson's mind was doubtless nearer to the actual meaning of the words he formed the generic title from—that of leaf-winged—and we may venture to call Dr. Günther's species the Leaf-finned Sea-horse.

The section on Fossil Fishes is very short, but a great deal of information is contained therein. "A large proportion of fossil fishes belong to the division Palæichthyes. This group comprises most of the fishes which have been met with in the primary rocks and many of those found in the Secondary strata; but in Tertiary deposits the Teleostean division is quite as well represented in the geological formations as in existing seas. There is no evidence of any gradual succession of fishes in the order of increased complicity of structure, as the deposits in which they occur approach nearer to the present day, and there is no reason to suppose that the oldest fishes known were the first that appeared upon the earth. The earliest fishes discovered were met with in the Lower Ludlow rocks, which form the upper part of the Silurian strata. The most ancient genus is Scaphaspis, a small buckler-headed fish, which had the body covered with scales. Many allied genera are found in the overlying Old Red Sandstone, in which fishes appear in extraordinary variety. Among the allies of Scaphaspis are Pteraspis, Cephalaspis, &c., some of which range down to the Silurian rocks. Near to these fishes must be placed Coccoosteus, Pterichthys, and the immense American fossil of Devonian age named Dinichthys. These fishes are thought to be related to Ganoids and Sharks, but in external form they more closely approximate to Loricaria, though the tail is heterocercal. They form a distinct group named Placodermi."

While four volumes and a goodly portion of a fifth are devoted to the Vertebrata, there are not wanting signs that the immense divisions of the animal kingdom here grouped as Invertebrata are to be treated of after the usual stereotyped fashion, and that at most one further volume will bring this series to a close. The Invertebrata, we are told, are divided into great types, or groups, which are (1) the Mollusca; (2) the Arthropoda; (3) the Vermes; (4) the Echinodermata; (5) the Zoophyta; and (6) Protozoa. "These great divisions are not exactly

¹ "Cassell's Natural History." Edited by P. Martin Duncan, M.B., F.R.S. Vol. v., illustrated. (London: Cassell, Petter, Galpin, and Co., 1881.

defined in nature, and they are subdivided into secondary groups, and are also united in some instances by forms of life which cannot well be placed in any particular one." We presume these "latter forms of life" are those called "intermediate groups," which are "(1) the Tunicata, which have a more or less leathery or cartilaginous covering sac." "They may be placed in the neighbourhood of the Vermes and Mollusca in their classification." "(2) The Molluscoida, which have the body with shells placed differently to those of the Mollusca, or have a tubular or shell-like covering." "The Bryozoa and Brachiopoda are included in this group, and in their structures, embryonic and adult, they show resemblances to those of Vermes, Mollusca, and Tunicata."

The chapters on Mollusca and Tunicata are by Dr. Henry Woodward; the Bryozoa and Brachiopoda by Agnes Crane; the introduction to Insecta and the account

of the order of the Hymenoptera is from the pen of Mr. Dallas, and the chapter on the order of Coleoptera is by Mr. Bates. In passing we may note that the reader will find no hint that the Arthropods are jointed-limbed animals containing the Crustacea and Arachnids, unless incidentally when Mr. Dallas is describing the true Insect type.

It is scarcely necessary to state that within the limits at his disposal Dr. H. Woodward has given a very interesting account of the Molluscan forms. We are glad to note too that he has devoted a good portion of his space to an account of the Cuttle-fishes, which is more exciting and interesting reading than the necessarily briefer accounts of such families as those of Cancellariadæ and Pyramidellidæ. The chapter on that "intermediate type," the Tunicata, is poor indeed, and not what we should have expected from its author. Surely we have



The Leaf-finned Sea-horse.

learned something more of this group since the writings of Forbes and Savigny.

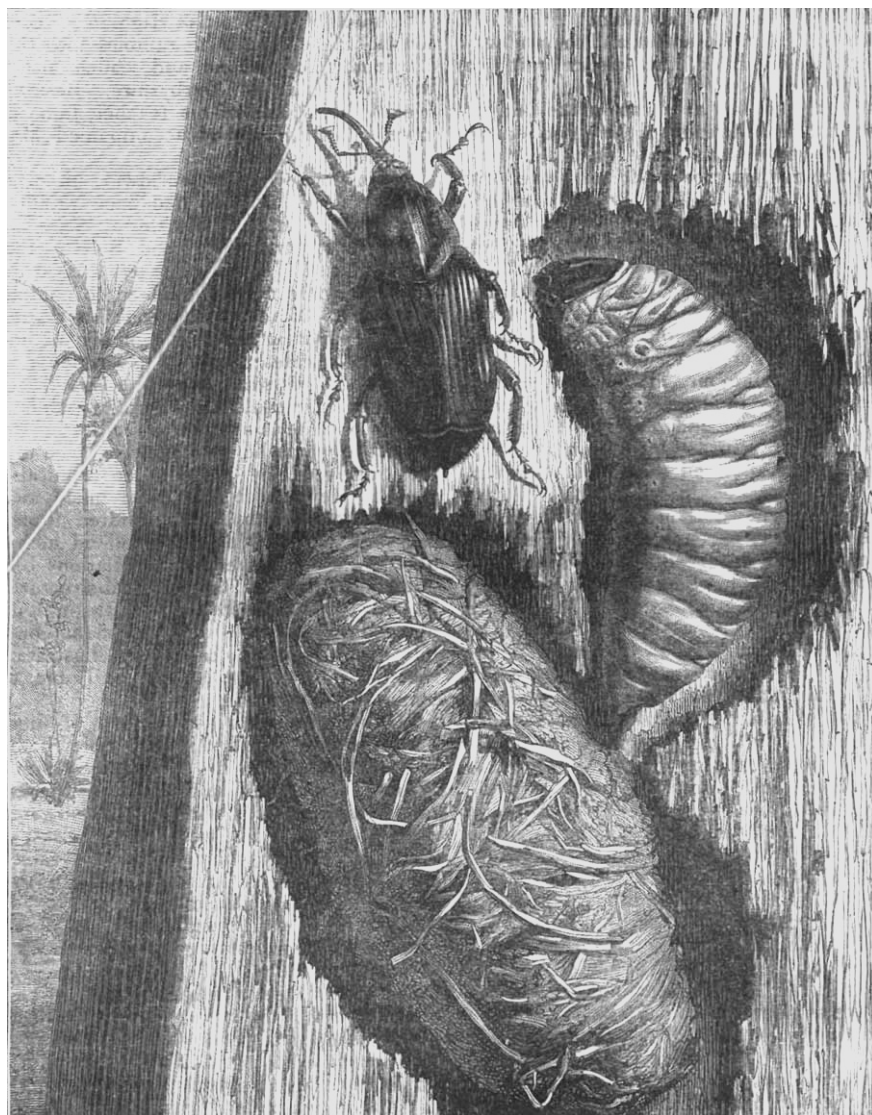
The chapters on the Brachiopoda and Bryozoa by Agnes Crane appear to be extremely carefully written. The illustrations—many of them—are refreshingly new, and taken from the best of sources. We altogether disagree with the authoress as to adopting the name of Bryozoa for the group she calls Sea-mosses, but she states the case for and against the use of the term Polyzoa most fairly; and nowhere have we met a more neatly compiled account, brought down, too, to the very latest date of this group—even the facts brought to light by the expedition of the *Challenger* are alluded to therein.

The introduction to the group of Insects is remarkably well done. The classification is primarily based on the presence or absence of a perfect metamorphosis, and the secondary divisions are based on the structure of the mouth. As for certain small groups of insects which

undergo no metamorphosis at all, "They may be residues of groups formerly more numerous and abundant, in which case they ought probably to be kept distinct from the other existing orders of Insects," or as we prefer to think, "they may be degraded representatives of the orders to which they appear to be most nearly related." The account of the first order on the list, that of the Beetles, is written by H. W. Bates, and few possess more knowledge of the many forms that compose this group. It need not be said that he does not attempt to treat of the 80,000 and upwards of known forms in the fifty pages at his service, but from what he tells us of the habits of those he does describe, we feel our interest in the subject increasing, until, when we come to the account of the Ladybirds, "upwards of 1500 species of which are known," we feel sorry that we have come to the very last line long ere the author had evidently come to the last of his subject.

We give, through the courtesy of the publishers, another illustration taken from the chapter on Weevils. It is of a weevil known as *Rhyncophorus palmarum*. Its fat grubs live on the stems of palm-trees, and are often

very destructive. Several of the species are very injurious to the sugar-cane. One found in sugar-plantations in Guiana contain in their intestines lumps of a sweet waxy substance—the altered saccharine food on which they



The Palm Weevil.

live—and for this they are boiled and eaten by the natives. The fine fat larva and the pupal condition, as well as the full-grown weevil, are to be seen in the engraving.

The account of the immense and important order of the Hymenoptera is written by Mr. Dallas; but only the history of the Aculeata is here given, and the other sections are reserved until the succeeding volume

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THE decade which closes this year will remain a memorable one in the annals of geology for the great names which appear in its obituary. Not a few of the early leaders, to whom it was possible to masterfully every department of the infant science and to strike out into new untrodden paths in almost any direction, have lived on to witness the vast development of the studies which they did so much to foster. In this country we have lost only lately Murchison, Sedgwick, Lyell, Phillips, Scrope,

whom we early learnt to reverence as demi-gods of the heroic age. And now to these names another falls to be added which, though not that of a Briton, has long been a household word among the geologists of this country. The veteran Ami Boué has just passed away. Ripe in years and universally honoured, he has remained perched on his beloved mountain slopes like a boulder stranded above the reach of the all-devouring sea. But the tide of mortality has at last swept him away, and has thus broken one of the most interesting ties that bound us to the early days of geology. Having for many years enjoyed